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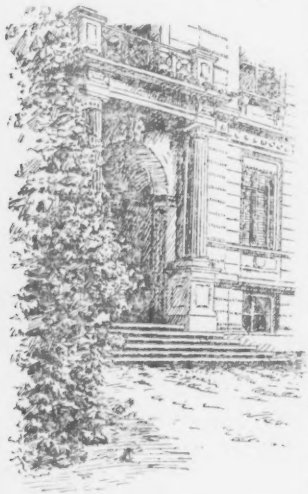
Strassburg and its botanical laboratory.

WILLIAM R. DUDLEY.

The city of Strassburg contains two widely different quarters; first, the old city, full of narrow streets and quaint houses, whose crown and glory is the great cathedral near its center; second, the new quarter, added to the city by the extension of its walls after the German occupation in 1871, and containing wholly modern buildings. Among the latter are the new imperial palace and the great quadrangle of the new "Kaiser Wilhelm" University. A considerable area of this new quarter is still unoccupied.



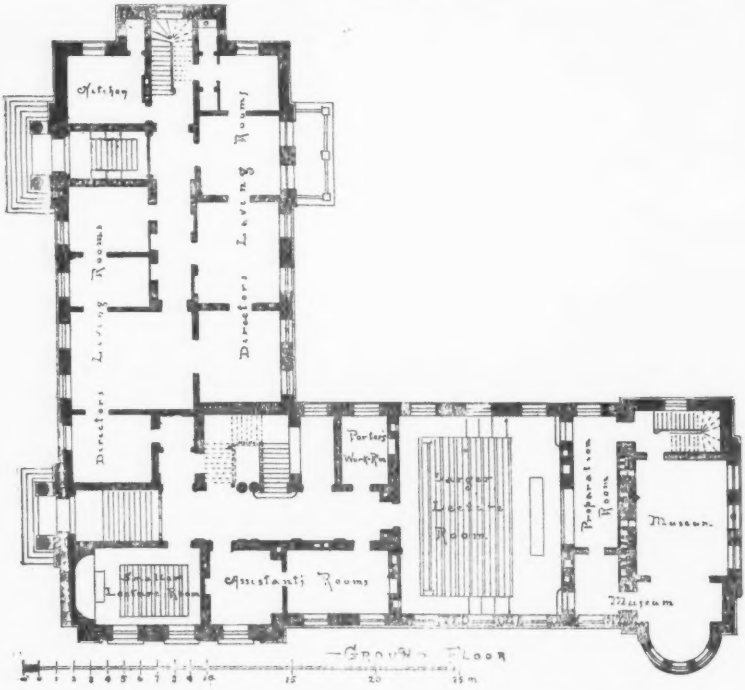
MAIN ENTRANCE TO LABORATORY, NORTH SIDE.

Extending across the end of the quadrangle and facing the distant palace is the great University building, 400 feet long, designed for lectures in philosophy, literature, mathematics, law, theology, etc. In the rear on the left side is the Chemical Institute; on the right the Physical and Botanical Institutes, and farther back the Observatory. Between the Botanical Institute and the Observatory lies the Botanical Garden with its greenhouses, Victoria House and artificial pond. On a neighboring quadrangle other buildings for science are being erected; in another part of the city are the numerous buildings of the Medical School, while the Library of over 600,000 volumes occupies the old Bishop's Palace near the cathedral.

It is rare to find the buildings of German universities grouped together in this altogether American fashion, or making such an imposing display as do these fine examples on the quadrangle of the "German Renaissance" style of

architecture. The structures are of a light-gray stone, often with stone staircases and corridors, and are fire-proof throughout.

A ground plan of two floors of the Botanical Institute, the ground floor and the story above the latter, called on the continent the "first floor," accompanies this sketch. These



are from tracings of drawings kindly furnished me by Prof. Zacharias and Dr. Jost, of the Institute, and deserve a careful inspection by all interested in laboratory arrangements.

Among the peculiar features, it will be noticed that a considerable portion of the building is reserved as a residence for the Director and his family, and that two rooms are allotted to the Director's assistant, commonly a young man who has recently made his doctorate. The writer also has plans of the basement and attic stories; and these show rooms for the porter and his family, and for that excellent

servant of German laboratories, the "Diener," or laboratory porter or waiter. To group all these people in the "Institute" building is a common practice in German universities.

The "Preparation Room," as it seemed best to call it on the plan, is one used in preparing for lectures, and is convenient for carrying on certain work in connection with the illustrative museum (or "Lehrsammlung") in the rear.

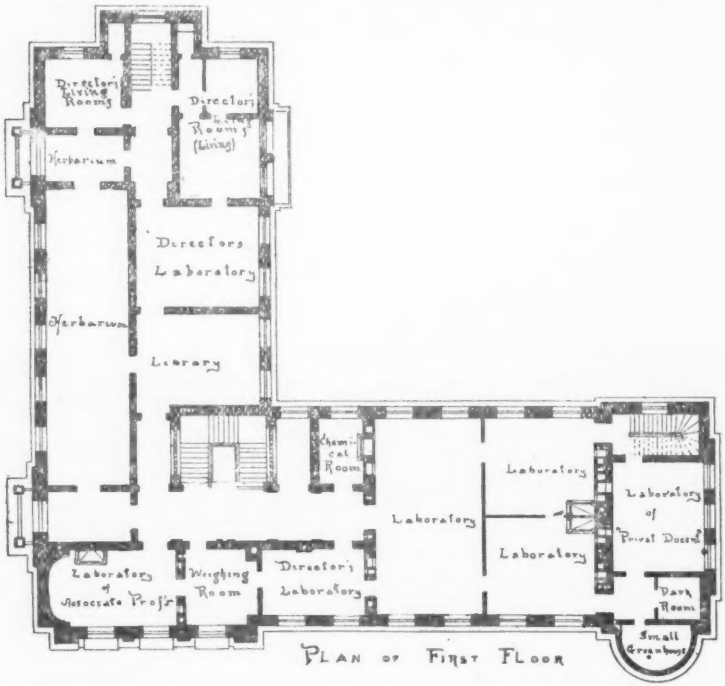
The little greenhouse on the first floor is of the greatest convenience. Sections of its glass roof can be raised, and, if necessary, a platform, bearing jars or pots containing cultures, can be rolled out on a track into the open air. The laboratory rooms are especially interesting, as representing the most recent expression of the mature judgment of Germany's ablest laboratory director, de Bary.

No doubt the architect who designed the building is accountable for cutting it up into symmetrical squares; any German architect who failed in this would be sure to die unhappy. Nevertheless, for the sequence of the rooms and for the details, de Bary was responsible, and, taking everything into consideration, it is considered in Germany their best single laboratory for botany.

Its chief characteristics are the abundance of all necessary appliances and apparatus, cleanliness and orderly disposition of all its supplies, good light from huge windows and white wall-surfaces. Wall-cases are numerous and the contained glass-ware, reagents, etc., nicely arranged. Drawers are abundant, this one containing only reagent tubes, that glass plates, another pipettes, burettes, etc., etc. Running water is convenient, of course, and distilled water and three grades of alcohol where they can be readily obtained by students if necessary. There are several sterilizing boxes in the large laboratories; also constant-temperature boxes provided with thermostats. The chemical room is provided with a hood for fumes and for the steam generated by the steam sterilizing cylinders. Gas is provided at each table, and a separate room is set apart for delicate instruments, such as balances. Indeed the association and dissociation of rooms and apparatus, the conveniences, the absence of unnecessary things and showy effects, indicate the intelligence and discernment of a worker and a master.

The tables are broad, very heavy and designed so as to prevent warping or seaming. They are convenient for two beginners or a single special student. Each person is provided, at the outset, with about a dozen common reagents

and fluids. The microscopes for laboratory use are chiefly Hartnack. Most of the private microscopes in the laboratory at the time I was there were from Seibert, an excellent Wetzlar manufacturer, not well known in America; and one or two from Zeiss. The stock of reagents in the cases is large, and, if necessary, new ones will be cheerfully ordered. The University requires of special students working every



PLAN OF FIRST FLOOR

day in the laboratory, a payment of fifteen dollars, which covers all necessary expenses.

Strassburg University had about 1000 students during the winter semester of 1887–'88, and 104 professors, privat-docents and assistants. It is, therefore, neither one of the largest, nor one of the smallest, of Germany's twenty-one universities.

The Botanical Laboratory had six advanced and five beginning students, and I do not think the number was affected by de Bary's illness. To instruct or counsel these were four instructors: The professor; the associate professor, Dr. Zacharias; the privat-docent, Dr. Wortman; and the assistant, Dr. Jost—all contributors, in a greater or less degree, to science, and of course well-trained men. At least three of the advanced students were working quite independently during de Bary's illness, although it was the latter's custom to inquire nearly every day after the work of the advanced students, when he was in health. But the German govern-

BOTANICAL LABORATORY, FROM THE GARDEN. SOUTH SIDE.

ment, which employs and pays these instructors, is not afflicted with that particular kind of malaria which enters into the management of almost every American institution, and gives it alternate chills and fever over fall and rise in numbers. Numbers are a matter of indifference to it. A very distinguished German professor once said to me: "The truth is, we teach whatever we please, we do as much or as little as we please, and the government does not interfere with us." Yet these men teach enthusiastically, and accomplish in scientific research ten times as much as the American professor, who is "personally conducted" by a whole board of trustees. The German government *does* "person-

ally conduct," however, in certain very important matters. In the first place it provides a suitable corps of assistants, and makes it sure, therefore, that the professor has *not* too great a burden of teaching on his hands. It provides ample appropriations; it appoints its professors for merit, and it sends up its students from the secondary schools with an excellent and uniform training.

The advanced students were mostly engaged in bacteriological investigations, although one was working out certain biological questions of fern development. Professor Zacharias was engaged in histological work, Dr. Wortman in physiology, and Dr. Jost completed a paper during the winter on the morphology of certain mistletoes.

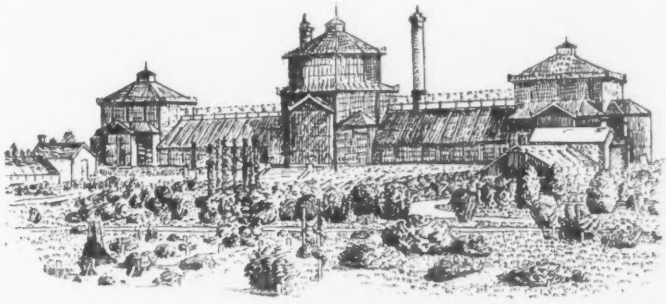
In the "Lehrsammlung" are numerous beautiful preparations, some made by de Bary, and at once recognizable as the originals of well-known figures in his published works; and some by former pupils, some of whom are now famous men. These preparations are frequently used in illustrating the lectures, all of which were held late in the afternoon or in the evening.

The herbarium collection is not relatively large, and is situated, it will be observed, rather remote from the other rooms. Had de Bary been a systematist, he would no doubt have placed his herbarium centrally. Instead, the large laboratories, the rooms which have seen so many distinguished investigators, and witnessed so many scientific discoveries under the guidance of the great director, are the rooms around which the others are clustered.

The library, stocked with a fairly good number of the important serials, together with a few standard works in the principal departments of botany, is placed nearer the laboratory; and in this, every Monday evening, meets the "Botanical Colloquium," made up of the advanced students of the laboratory and the instructors. Certain members give carefully prepared abstracts and reviews of the current botanical literature, which are followed by spirited discussions. After an hour or more of arduous and profitable labor of this kind, by means of which each member is enabled to keep quite abreast of advanced lines of work, they adjourn to a more convivial place and spend the remainder of the evening in the relaxation natural to the German. By eleven o'clock all their vast learning, and especially the hard facts of the recent Colloquium, are in a state of saturated solution, and by next morning are quite ready for use.

The foreigner who has attended a German university

always recalls the university town with feelings of decided pleasure. The quaintness and character of most of these towns, especially in South Germany, furnish a pictorial setting to his experience and work that is wholly new to him. Strassburg, a city of about 115,000 people, has an individuality greater than most cities. From its strategical importance it has been much fought over, and a variety of ownership has given it a mixed population and a mixed language. One sees on its narrow streets the dark complexion and regular, handsome features of the Frank combined with the strong frame of the German, and hears both languages spoken by the same person with equal fluency. And the



LARGE GREENHOUSE IN BOTANIC GARDEN.

peasant on the country road or in the market, and the blue capped and cloaked school-boy on the street, shout their Alsatian *patois*—neither French nor German—in the singsong, cheery tones peculiar to the people of the Upper Rhine valley. It is the strongest fortress in Germany, and the presence of a garrison of 12,000 gives it a lively military aspect. Gœthe took his degree in the university, studied here with Herder, Lenz, Lavater and Stilling, and the bryologist Schimper was long a professor here. Indeed, when one reverts to the numerous associations connected with every ancient street and square, and with many of the houses whose steep, tiled and chimneyed roofs and rich wood-carving date back two to four centuries, and especially when he recalls that most attractive of the old Gothic cathedrals and the scenes witnessed in and around it, he can readily appreciate the loyalty the exiled Strassburger is always said to feel.

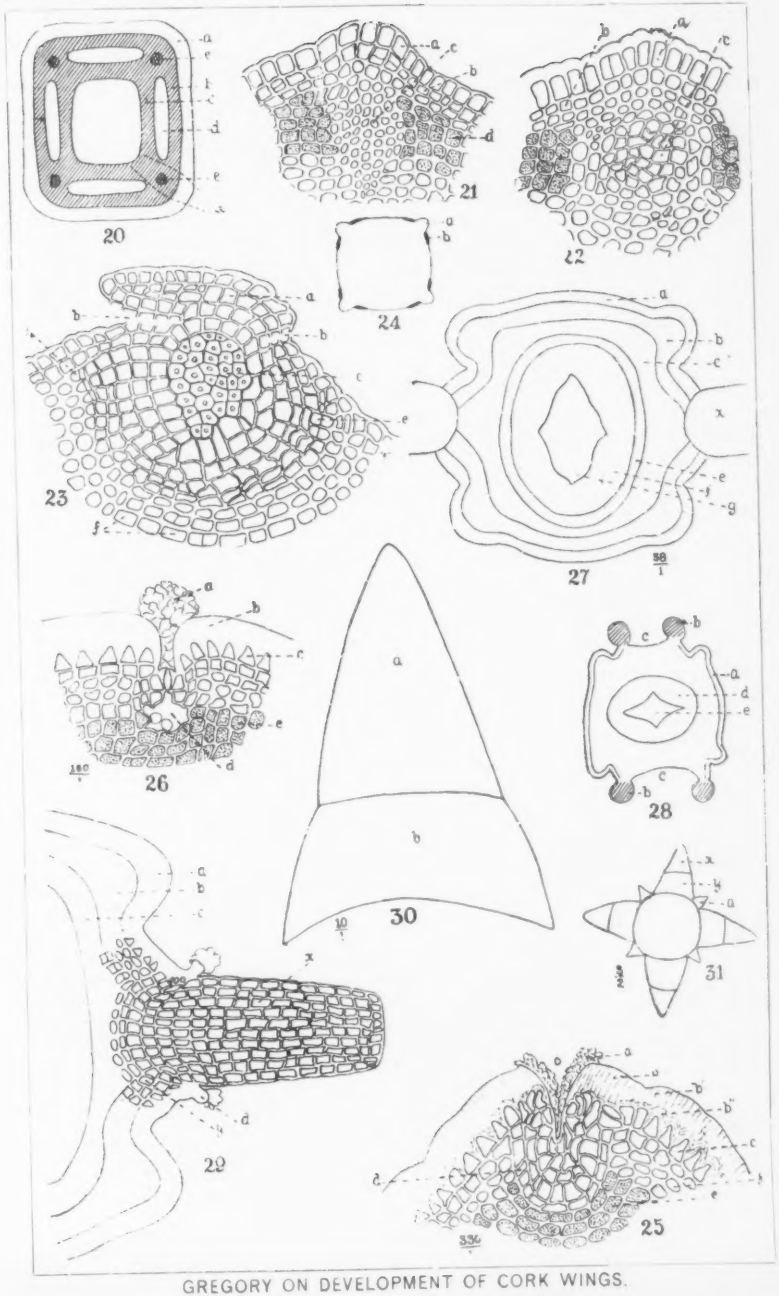
Strassburg.

Development of cork-wings on certain trees. III.

EMILY L. GREGORY.

(WITH PLATE XXV.)

Of the genus Euonymus, the species now known as alatus, formerly described as *Celastrus alatus* Thunb., presents the most marked and striking example of what is known as cork-wings. The first important consideration on taking up the study of the wing in this genus is, that we have no longer to do with large trees, but with small ones and shrubs. One of our own native varieties, E. Americanus var. obovatus, Gray describes as trailing with rooting branches. Another species has small rootlets scattered over the branches. Closely connected with this fact is another of equal importance, that is, the lasting nature of the epidermis, or the length of time that some part of the surface of the stem performs the function of assimilation. Of the thirteen kinds of Euonymus examined, only five may be said to be winged in the sense in which we have used this term. Nearly all the others, however, present some features which are of use in determining the probable reason for this peculiar formation, exhibited in its strongest form in Euonymus alatus. A complete study of the periderm development of this genus would lead to a more extended treatment than was intended when limiting the study to the development of cork-wings. Certain parts of this subject must therefore be reserved for future consideration, and only those kinds described here which are really winged. These are E. alatus, E. Europæus and three varieties of the latter species, variegata, ovata and purpurea. A comparative study of these five kinds shows little difference existing in the anatomical structure of the wing of Euonymus Europæus and its three varieties. Any one of these may be described as illustrating a weak and less developed form of wing which finds its complete development in E. alatus. The structure of the primary rind of these four kinds is very nearly the same. The mechanical support, which in most dicotyledons and gymnosperms is furnished this rind by means of the bast fibers of the primary vascular bundles, is here wanting. In place of these are two cylinders of collenchymatic cells. These cylinders are connected at each corner by collenchymatic tissue extending from one to the other. This will be readily understood from the diagram, fig. 20. In this, *a* represents the epidermal layer; *b*, the



GREGORY ON DEVELOPMENT OF CORK WINGS.

outer cylinder of collenchymatic cells; *c*, the inner, and *d*, the thin-walled chlorophyll-holding cells, which serve the purpose of assimilation, and also to separate the collenchymatic tissue of the rind into the two cylinders. At each corner, *x x*, the collenchymatic tissue extends through to the young phloem tissue. In the species and in the varieties purpurea and variegata the corners are further strengthened by a cluster of extremely thick-walled bast fibers, and it is here at the corners that the wing formation begins. The time varies according to several conditions. One example of E. Europæus just brought in from the tree, September 28th, has one stem on which wings are forming on the second internode, while this is only one-half centimeter in length. On the same plant, another stem has fully 20 centimeters of its length without any appearance of wings. Several internodes of this are fully developed in length, and the lines of bast cells are visible along the four corners.

The wing development on a branch of the variety purpurea was studied from its beginning. A cross section at the distance of ½ centimeter from the growing tip of stem shows the tissues of the rind in a formative stage. The outer wall of the epidermal cells is covered by a thin cuticle, the cells themselves are large, nearly isodiametric, and with thin walls; below the epidermis are two layers of thin-walled cells without chlorophyll, then 4 or 5 layers of parenchymatic chlorophyll-holding cells, and below these again several layers of colorless cells. At the corners of the stem (see fig. 21) the cells connecting the outer and inner cylinders of colorless cells are thick-walled and more or less collenchymatic in structure. A section cut at 3 centimeters from the tip of the stem shows that several important changes have occurred. The two cylinders of colorless cells now begin to take on a collenchymatic appearance, the walls having thickened considerably. The cells of the epidermis are in a state of rapid growth and division, new cells being added to the outer cylinder, whose walls rapidly thicken, as may be seen by sections at the distance of 5 and 7 centimeters from the tip. The cells in the center of the group in the corners (see *c*, figs. 21 and 22) are seen to have increased in diameter, while at the same time their walls are much thinner. These are the cells that afterward become the thick-walled bast fibers. (See *c*, of fig. 23.) There is just here a point of interest in regard to the origin of these bast fibers. Connected with it are also some other facts noted while making this study;

their consideration at the present time would lead us away from the subject in hand and it is therefore deferred. After the bast cells are well developed there begins a change in the character of the remaining collenchymatic cells lying immediately below them; these begin to stretch tangentially, then to grow and divide by radial walls, so that the circumference of the stem increases more rapidly at the four corners than elsewhere, and at this point, and apparently to meet this emergency, the phellogen layer of the cork-wing arises. A layer of collenchymatic cells extending entirely around the bast cells and joining those under the epidermis becomes the phellogen layer of the cork-cells. In using the word collenchymatic here, it must be understood as referring merely to the shape and thickness of the wall, and not to its nature as permanent tissue. The entire cells of the rind are up to this time in a growing, changing condition.

The origin of the cork-cells may be plainly seen on a section cut at a distance of 25 centimeters from the tip. Here at the points marked *c c*, on fig. 23, may be seen very distinctly the last wall formed in the phellogen cells. It is extremely thin, while the opposite wall of the same cell is very thick. In order to follow the course of growth, the sections were treated as recommended by Sanio, first placed in ammonia, then carefully washed and mounted in glycerine. The rapid growth of the phellogen pushes out the corner cells carrying the bast cells, a break of the epidermis occurs on either side, see *b b*, of fig. 23; this goes on till a wing of some size projects from each corner. The usual narrow plate cells mark the end of the season's growth. It is seldom, however, that the second season adds very much to the size of the wing. In the variety ovata, which lacks the bast fibers, the second season's growth of cork-cells appears to spread out from the outer phellogen cells of the first, so the circumference is increased with but very little outlay of material. (See fig. 24.)

Taking up now E. alatus, there are four sharp thin wings extending along the internodes, not at the corners, but as nearly as may be exactly between them. The bright green of the assimilating cells shows in strips between the wings, forming a peculiar contrast in color with the brown of the wings. The structure of the rind differs from that of the varieties already described. The stem is sharply four-angled, but the chlorophyll-holding cells extend entirely around it. They consist of several layers very similar in character

to the palisade cells of the leaf. There are no bast cells in the corners. The beginning of the wing takes place ordinarily after the internode has reached its length. The first indication of it externally is a little line of brown flecks at equal distances from the ridges at the corners. These may easily be mistaken for lenticels, but on examination they are found to be the first stages of the wing which originates directly from the stomata. These are distributed thickly and evenly over the surface, are sunken quite deep, as is usual on stems or leaves with a thick cuticle.

This line of brown spots extends along the entire internode, and a cross section through the middle of one of them gives the appearance as in fig. 25. One or two thin sections distant from this strikes across the end of the brown fleck and shows its stomatic origin (see fig. 26). In fig. 25, the cells marked *d* are the phellogen cells, and by contrasting different sections it is seen that these originate in the chlorophyll-holding cells under the air space, and at least three or four layers below those lining it. In this way the cells immediately about the air space are pushed out by the growing cork cells, are more or less broken, and form a debris around the openings of the stomata (see *a* in figs. 25 and 26). In fig. 26 this debris comes from the chlorophyll-holding cells of the central portion which have been shoved over to the end. This exudation is the peculiar mark of this species, for it is sufficient to form a ridge on either side through which the wing pushes its way, and when grown appears to rest in it as in a sort of socket. That this socket forms no part of the wing, is seen from the fact that if the latter be forcibly broken from the stem, the socket always remains, and can only be removed by cutting. (See fig. 28, *d*.) Continuing now the description from the stage seen in fig. 25, new cells are rapidly thrown off by the phellogen layer toward the circumference, and these appear between the ridges in a wedge shape at first, but the phellogen layer rapidly increases the number of its cells by dividing radially, so that the wedge grows rapidly broader at the base. The plate cells mark the end of the year's growth; the second season it is again resumed and continued during the entire summer, quite as much material being expended in this way as in the preceding summer, and from the same layer of cells. There is generally a difference in the color of the two parts of the wing, the second year's growth being lighter. The assimilation cells between the wings remain active until the third season,

at which time there often begins the formation of four new ones, which fill up the spaces between the old ones, and thus the whole surface of the stem becomes covered with a periderm, and the phellogen layer becomes continuous. In other cases the intervening spaces are not covered by means of a regular wing, but the cork formation seems to occur about the same time under all the stomata, so that after a time the whole surface is covered by an irregular periderm which grows up nearly even with the sharply projecting wedges of the wings.

Euonymus Americanus has a rind very similar in structure to that of alatus; it has, however, bast fibers in the corners, but they lie below the chlorophyll-holding cells. No wings have been discovered on this species, but it is rather a suggestive fact that on some young branches a line of cork growth often occurs running along the internode, neither in the middle between, nor exactly at, the corners of the stem, but close by these projecting corners. This growth never develops into more than a little brown ridge along under the green one of the corner. It is well known that Euonymus verrucosus has warty projections of cork, which are said to arise from lenticels, though at the time of their origin there is no appearance of periderm, unless the outer cylinder, which we have described as collenchymatic cells, be considered periderm.

Now, if the origin of the wing formation in the preceding five kinds of Euonymus has been correctly traced, it would seem that the usual statement made in reference to the periderm formation of Euonymus is not literally correct when applied to these five kinds. The periderm does not originate from the epidermal cells, if by periderm is meant the corky growth covering older stems, but from certain layers of cells at a greater or less distance below the epidermis. The cells which are cut off from the epidermal layer form an additional support to the outer collenchymatic cylinder, which at first is only two layers in thickness. By means of these additional cells from the epidermis the number is increased often to six or seven layers.

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EXPLANATION OF PLATES XXII AND XXV.—The first six figures represent diagrammatically the phases of growth of the wings of Quercus macrocarpa. The first four represent one year's growth, the fifth and sixth slightly different phases of a stem of three year's growth; *a a*, the break of the periderm tissue along the line of the five angles; *o o*, the

sections of original periderm tissue separated by these fissures; *x x*, the new tissue formed from the phellogen cells after the fissures occur; *y y*, the girdle of narrow plate cells whose walls are of the same chemical nature as those of sections *o o*. The lines between the points *b b*, in figs. 2 and 3, show the band of cork-cells; after the first year's growth the whole circumference is covered by these bands.

FIG. 7. Shows appearance of cross-section of a one-year-old stem in the region designated by *b b*, in fig. 2. The letters correspond to those of fig. 2, except there is in this figure *z*, the parenchymatic cells of the primary cortex or rind, and *m* shows a cell which has recently divided, making three cells.

FIG. 8. Cross-section of one-half of a wing in the stage represented in fig. 4. Lettered to correspond.

FIG. 9. Cross-section of top of wing as represented in fig. 6, stem three years old; sketched after treatment with reagents, therefore walls somewhat distorted.

FIG. 10. Cross section of a stem four years old, natural size. Lettered as the previous figures.

FIGS. 11 to 13 inclusive. Acer campestre. Fig. 11 shows outline of cross-section of first year's growth of stem; *x*, a wing already straightened out along the margin, the hairs at *h* shewing that the epidermis is still preserved here. Letters correspond as far as possible to those of Quercus figures.

FIG. 12. Anatomical sketch of cross-section of wing as represented in fig. 11 by the wings x^0 x^0.

FIG. 13. Cross section of a two year's old stem, natural size.

FIG. 14. Acer monspessulanum; diagrammatic sketch of a cross-section of a two-year-old stem. Letters correspond nearly: *f*, fissure; *x*, first year's wing; *x'*, second year's wing.

FIGS. 15 to 19 inclusive. Liquidambar styraciflua. Fig. 15. Anatomical sketch, in part diagrammatic, of beginning of wing: *a*, the fissure at the opening of lenticel; *b*, fissure made by the cells growing below.

FIG. 16. Cross-section of second year's growth, exact outline; cut June 24th. *a* and *b*, fissures as in fig. 15, *b*; *x*, first year's wing; *x'*, second year's wing; *y*, narrow plate cells of first year; *y'*, those of second year.

FIG. 17. Cross section of two years' old stem.

FIG. 18. Cross-section of four-years' stem.

FIG. 19. Cross-section of six-years' stem.

FIG. 20. Diagram of rind of E. Europæus and varieties. *a*, epidermis; *b*, outside collenchymatic cylinder; *c*, inside cylinder; *d*, chlorophyll holding cells; *e*, bast fibers in corners; *x*, the collenchymatic cells extending to phloem cells.

FIG. 21. Corner of E. Europæus var. purpurea; cross-section cut from stem ½ cm long. *a*, epidermis; *b*, colorless cells below; *c*, collenchymatic cells of corner; *d*, chlorophyll-holding cells.

FIG. 22. Same as 21, but cut at a distance of 3 cm. from tip of stem. Letters as in 21, except that the cells *c* can no longer be called collenchymatic.

FIG. 23. Same as 21, but cut at a distance of 25 cm. from tip of stem. *a*, section of cells burst away from the remaining part; *b b*, the breaks on each side; *c*, bast cells now fully developed; *e e*, phellogen cells, one side of which still show their collenchymatic origin; *f*, elongated collenchymatic cells.

FIG. 24. Diagram of stem of E. ovata wing of first year's growth; *b*, cork growth of second year.

FIG. 25. E. alatus, beginning of wing. *a*, debris formed by the remains of chlorophyll-holding cells of stoma which lined the air space; *b*, heavy cuticle of epidermis in two sections as seen by *b'* and *b''*; *c*, epidermis cell; *d*, cells of phellogen layer; *e*, chlorophyll-holding cells; *f*, collenchymatic cell; *o*, opening of stoma.

FIG. 26. Shows the origin of growth in fig. 25 more plainly: *a*, the debris thrown to the end; *b*, cuticle; *c*, epidermis; *d*, air space of stoma; *e*, chlorophyll-holding cells.

FIG. 27. Diagram of young stem of E. alatus, with only two wings started: *a*, epidermis and outer cylinder; *b*, palisade cells; *c*, inner cylinder; *e*, young cells of phloem and cambium layer; *f*, wood cells; *g*, pith; *x*, wing broken off.

FIG. 28. Sketch of cross-section at early stage, showing how much is gained in circumference by the wing formation. Only two started and not far developed: *a*, epidermis; *b*, debris around the opening of the stoma; *c*, space with no epidermis where wing belongs; *d*, wood; *e*, pith.

FIG. 29. Same as 25, but represents the wing well started: *x*, wing; *y*, phellogen cells; *a*, epidermis and outer cylinder; *b*, palisade cells; *c*, inner cylinder; *d*, cuticle and debris.

FIG. 30. Sketch in outline of a two-year-old wing: *a*, the first; *b*, the second year's growth.

FIG. 31. Cross-section of two-year-old stem: *x*, first year's growth of wing; *y*, second year's; *a*, little wing of second year.

A tramp in the North Carolina mountains. II.

L. N. JOHNSON.

One of the first plants to catch the eye of a stranger in the mountains is the Rhododendron. Before we reached Asheville we began to notice its dark glossy leaves and beautiful pink clusters, brightening the woods along the track, and as we got further west it became abundant. All through the mountains we found the common R. maximum, and we never tired of looking at it. In the lower vallies it was past its prime, but on the highlands and along the ridges it was in full bloom, and the great thickets of dark green, thickly starred with the rose-colored flowers, were worth going far to see.

In Cashier's valley they find the purple-flowered R. Catawbiense, but not a single flower could we find still hanging to its branch.

Another, and the most interesting and remarkable member of the genus, is the R. Vaseyi. This, too, grows in Cashier's valley, over toward Chimney Top. We saw it growing with most of its interesting neighbors in the exten-

sive grounds of Mr. H. P. Kelsey, at Highlands. We are indebted to him for the facts concerning its history.

It was discovered by Vasey, some ten years ago, near Webster, in Jackson county, and not long after in Cashier's valley. It belongs to a section of the genus most of whose representatives are Asiatic, and hence its discovery here was especially noteworthy. It has a bright pinkish corolla, and some of the lobes are spotted at the base, as in R. maximum. It differs markedly from our other rhododendrons in having deciduous leaves.

Jackson county was believed to be the only locality for the species till Mr. S. T. Kelsey discovered it, growing in abundance on Grandfather Mt., Mitchell county, N. C. In each locality it forms great beds, and when in full bloom is said to be magnificent. In Jackson county it grows in rather low grounds, and intermingles with R. maximum, Azalea calendulacea, and A. aborescens, while on Grandfather Mt. it is massed with R. Catawbiense and Kalmia latifolia mostly. It grows almost on top of the mountain, at an elevation of nearly 6,000 feet.

Growing with the Rhododendrons, and, of course, related to them, were the Azaleas, as we have mentioned. The large white blossoms of A. arborescens shed a delicious fragrance along the river banks, but not till we reached the highest mountains did we find A. calendulacea still in bloom. On Wayah Bald, in the Nanteholas, we at last came upon a thicket fairly ablaze with its brilliant flame-colored flowers. It is certainly the most showy species of the genus. The blossoms change their color with age, so one may find on the same hill-side flowers of every shade from scarlet to yellow. Both these species reach a height of a dozen feet or more.

One can not fail to be impressed with the great size reached by many of the Ericaceæ in these mountains. Besides the Rhododendrons, Kalmias and Azaleas, which often reach the size of small trees, there are, among others, a tree-like Clethra (C. acuminata) and the Sorrel-tree (Oxydendrum arboreum). We several times, from a distance, mistook the long, fragrant white racemes of the former for those of the latter, but it was a careless blunder. The Clethra bears its racemes singly on the tips of the branches, while the long, one-sided sprays of the Sorrel-tree are clustered. The flowers of the latter, examined singly, are not particularly beautiful, being only white bells about the size and shape of the blossoms of Vaccinium, but when massed they present a

striking appearance. We saw trees of this species which were probably thirty or forty feet high. It takes both its scientific and its common name from the sour taste of the leaves.

We found the Vacciniums almost everywhere, some of them reaching almost to the dignity of small trees, and several possessing an interest to a hungry man aside from their botanical peculiarities. They were in fruit at the time of our visit, though not generally ripe.

One of the most common plants along the water-courses was a puzzle to us for a time, especially as it was in full fruit. Its drooping branches were thickly set with alternate spinulose serrate evergreen leaves, arranged in two ranks, and beneath were long, densely-packed racemes of green fruits, resembling those of Andromeda. It was at length identified as Leucothoe Catesbæi, which blossoms in May and June, fringing the streams with white.

On the very top of Whiteside, growing on the rocks, in the moss, we found a beautiful little heath—Leiophyllum buxifolium. It reaches a height of only five or six inches, and its glossy evergreen leaves are closely matted together. We were, unfortunately, too late to find it in bloom, but, judging from the fruits, it must a month earlier be literally covered with the white flowers.

It seemed like a glimpse of the New England woods to find, as we climbed the mountains, the ground along the road-side covered with the trailing arbutus. We found it on almost all the mountain-sides, and in a few places saw another old friend—the wintergreen.

There were many other small Ericaceæ in the woods—among them the Chimaphila maculata and the two Monotropas, but doubtless the most interesting member of the family in all this region is the Shortia galacifolia. This did not come within the range of our tramp, but we were fortunate enough to see it growing at Mr. Kelsey's, and to obtain specimens. The history of the plant is perhaps not familiar to many of our readers.

It was discovered years ago and described (I think from a specimen in fruit), but the exact locality was forgotten, and all efforts to rediscover it failed till within a few years. Now it is known that in one locality at least it exists in abundance, and it is somewhat of a puzzle how it remained unknown so long.

We ascertained what was possible in regard to its habitat

from Mr. Kelsey, who visited the region last spring and collected many specimens, both plants and flowers. We can not do better than let him tell the story in his own words. He says: "Its native habitat is on or near the banks of the Jocassee (lower Whitewater) river, in Jocassee valley, Oconee county, S. C., about thirty-three miles from Highlands. When I was there—the middle of March—it was in full bloom and covered the banks of the river by acres, and extended up and down the river more or less for three miles. In places it grew in solid beds like the Galax aphylla. This one locality, as far as is known, is the only place where Shortia grows in the world, and until quite lately its real presence here was not positively known and determined."

It was growing in abundance on his place, in the shade along the banks of a little brook, where it had been transplanted. With it grew the Galax aphylla, with which we had already become familiar. It was easy to see how Shortia gets its name galacifolia. The leaf very closely resembles that of Galax in general appearance, though the latter is heart-shaped at the base and crenately-toothed, while the former is nearly orbicular and serrate, with rounded mucronate-tipped teeth. In each all the leaves are gathered in a radical cluster. While to one familiar with both the differences are plain, we could see that it would be very easy, on a hasty examination, to confuse Shortia with Galax, when not in flower. May not this partly explain why it has not sooner been recognized? It seems likely that it must exist in other parts of that region, but the chances are certainly in favor of its being overlooked, from this resemblance to Galax, which is abundant almost everywhere in the mountains. This is especially true on account of its very early time of flowering —before most of the spring flowers are out.

As for the flowers themselves, we only saw a single dried specimen, so our description is not worth much. If I mistake not, there rises a slender scape-like stalk from the cluster of radical leaves, and this bears a single blossom about three-fourths of an inch in diameter. The dried flower resembled slightly that of Chimaphila, and like that was white.

In closing this brief account of some Ericaceæ of the mountains, we would call attention to the great number which bear evergreen leaves. Not only are there many small ones like the wintergreen and the Arbutus, but the great masses of Rhododendrons, Kalmias and others, must keep the woods green all the winter through.

Evanston, Ill.

BRIEFER ARTICLES.

Some Maine plants.—A residence of two months during the past summer in Dennysville, Me., very near the "jumping-off place," known as Sail Rock, the most eastern extremity of the United States, and sundry excursions botanical and piscatorial along the coast for fifty miles or more, brought to light a few botanical facts of interest.

Euphrasia officinalis, previously collected on the Plains of Abraham, near Quebec, of very dense, compact habit, here occurs in great abundance, so as to be quite conspicuous along the roadsides, and even over the pastures, but loose and branching. It is not found farther inland than twenty miles, but extends along the coast as far as Marchion.

Rubus Chamæmorus, the cloud-berry, known among the natives as "baked-apple," occurs in sphagnous swamps in such quantities as to be brought to the stores for sale, though not very attractive to most of us. Mr. Kennan says that the Siberian variety is much more palatable. I had hitherto seen this only on some of the summits of the White Mountains.

Empetrum nigrum occurs also abundantly in company with the last.

Rhinanthus Crista-Galli is a troublesome weed in the fields and pastures within a few miles of the coast, its inflated seed-vessel rendering it quite conspicuous in fruit.

Mertensia maritima is found sparingly along the sandy borders of seabeaches, and has been noted as far west as York, Me.—J. W. CHICKERING, JR., *Washington, D. C.*

An erratum.—In the record of Dr. Gray's careful determinations of the Gamopetalæ of Dr. Palmer's Jalisco plants, included in my "Contribution xiv" (Proc. Amer. Acad. xxii), there occurs a single error which I desire to correct. On page 432, under *Cacalia tussilaginoides*, the "ex char." should be erased, leaving the determination, as Dr. Gray intended it to be, "Cacalia tussilaginoides, HBK. Nov. Gen. & Spec. 4.168?" The first reading was as given after his examination of the material in the Kew Herbarium, where he found Coulter's Zimapan specimen, to which he refers as intermediate between Palmer's and the original plant as described by Humboldt and Bonpland. In Paris he found the very specimen upon which the species was founded, but this left him still in doubt as to the identity of Palmer's plant with it. In consideration, however, of the deciduous character of tomentum generally (which in this case is, as described, thin and rather scanty—"folia subtus tenuiter cano-tomentosa") and the tendency of the foliage in *Cacalia* to vary, he deemed it prudent to let his Kew determination stand, and ended his note to me with, "Just print that name with an ?." In correcting the proofs in accordance with his latest conclusions I neglected to dele the "ex char." as I should have done.—SERENO WATSON, *Cambridge, Mass.*

Some Indiana plants.—*Viola pedata* L., var. *bicolor* Gray. This handsome variety is found to a limited extent on the sand ridges east of Hammond, Lake county. I have as yet found it in but one locality, near the Michigan Central Railroad, and have transplanted it to the flower garden. It blossomed a second time in the garden the past summer. It was transplanted while in flower, as that is the only time the variety can be distinguished amid the great abundance of the common form, which grows by the acre in the open sandy grounds.

Cnicus undulatus Gray. Sand ridges near Pine Station. The plant is not very canescent, only whitish. It is from one to two feet high, most commonly from twelve to fifteen inches, and usually with a single head. I had noticed this plant for some time, but had passed it by as the common pasture thistle (*Cnicus pumilus* Torr.). But not being quite satisfied with so superficial a determination, and a botanical friend collecting with me having asked its name, in order to be sure of a right answer, it was examined critically, and found to be as above. It is not a matter of surprise to find it in the neighborhood of Chicago, as so many of the plants regarded as belonging farther north come up to the south end of Lake Michigan. It seems less white-woolly than the described form, but in structure of involucre and leaves is identical. In canescence it by no means equals its neighbor, *C. Pitcheri* Torr. The latter grows close by the shore of the lake, in the comparatively naked sand ridges, where the wind has free play, and is often partly buried in the drifting sand, while *C. undulatus* frequents the ridges away from the shore, more or less covered by a variety of plants.

Pogonia pendula Lindl. occurs in the damper grounds amid the pines of the same neighborhood. The flowers are white, or but faintly tinged with pink.

Solanum rostratum Dunal. Near Liverpool, Lake county, by the Fort Wayne railroad. Only a few plants were seen, evidently introduced by the railroad. Should it become thoroughly established, it would be a very troublesome weed, on account of its prickly habit.

Cedar Lake, near Crown Point, has furnished two specimens of Potamogeton that I have not found elsewhere in the vicinity of Chicago, *P. Robbinsii* Oakes, and *P. prælongus* Wulfen. On account of the number of species, the lake is good collecting ground for this genus and other aquatics.

It is not very difficult to find here *Ceratophyllum demersum* L. in fruit, though I have looked for fruit by the hour in other localities. In fact, I have never found it but once or twice in fruit before the summer of 1886.—E. J. Hill, *Englewood, Ill.*

CURRENT LITERATURE.

Origin of floral structures.[1]

This is No. 63 of the "International Scientific Series." There are many figures of flowers and their parts, and many observations on the characters, insect relations and variations of flowers, which have a value quite distinct from that of the theory which is advanced.

Having laid aside the most fruitful principles which have been applied to the elucidation of floral mechanisms, the author goes back to the "monde ambiant" of Geoffroy Saint Hilaire, and undertakes to account for the forms of flowers as the *direct* result of insect agency. Insects stimulate "the flowers till they become thoroughly adapted to their visitors." Conversely, the neglect of insects is "accompanied by corresponding degradations in the perianth, stamens and pollen." The flower, "if it be visited by many, will presumably take a form corresponding to the resultant of the forces brought to bear upon it; if visited by few, it will shape itself in accordance with the requirements of its principal visitors." This considers flowers as developing in a way subservient to the uses of insects, instead of as utilizing them as servants. Adaptations for crossing, being the result of the direct agency of insects, have nothing to do with any advantage resulting from cross-fertilization. The Darwinian theories of natural selection and of cross-fertilization are thus wholly repudiated. But we are so far from being convinced that insects have given rise to useful variations that we even doubt whether they have induced any of the modifications which have been appropriated through natural selection. Moreover, it is easy to show that the characters of flowers are not what they would be expected to be according to the theory. In regard to irregularity he says: "The immediate causes, I repeat, I could recognize in the weight of the insect in front, the local irritation behind, due to the thrust of the insect's head and probing for nectar, coupled with the absence of all strains upon the sides."

But in sternotribe flowers the part which the insect touches the least is the strongest developed. Thus, in Papilionaceæ the banner is quite as large as the two lower petals together, and often as large as the four others, and is largest in those flowers in which it touches the insect the least. The labellum of orchids is a similar case, and its enlargement, instead of being a result of its use as a landing after inversion, is rather the cause of the inversion. The theory involves equal disregard of the function of the expanded parts of flowers and of the conditions under which they were developed. As an example of a flower in the first stage of irregularity, the author cites Verbascum, a descendant of the ancient zygomorphous type of Personales. The two genera with which it forms the

[1] HENSLOW, REV. GEORGE.—The Origin of Floral Structures through Insect and other Agencies. pp. xx, 350. New York: D. Appleton & Co. 1888.

Verbasceæ are didynamous, and it is evidently of that type. The corolla has become so shallow as to expose the stamens so that insects could light upon them, and the fifth stamen has resumed its antheriferous function. The enlargement of the lower lobe and the unequal length of the stamens, instead of indicating an incipient stage, as the author supposes, refer rather to a former condition. Although it is evident that natural selection must act, at least until after dissemination, we are told, in chap. xxxii, that "the principal period of the struggle for life takes place in the seedling stage, before any varietal and specific characters have appeared." The search for the reason of the author's views is rewarded in this chapter, where we read: "I must confess, it (natural selection) conveys nothing definite to my mind." Having observed that insects have something to do with the forms of flowers, the author is thus under the subjective necessity of referring these forms to their direct instead of their selective influence. However, the book can not be said to be without an important theoretical bearing, since it tends to support the view that but for the principle of selection the theory of evolution would be where Lamarck left it.—R.

NOTES AND NEWS.

A VOLUME on the folk-lore of plants, by T. F. Thiselton Dyer, is announced from the press of Appleton & Co.

THE BOTANISCHES CENTRALBLATT, which has for so long been published by Theodor Fischer, has been transferred to the house of the Gebrüder Gotthelft.

MR. B. FRANK LEEDS reports Euphorbia peplus as spreading rapidly in Santa Clara county, California. E. Lathyris, in the same region, attains a height of six or seven feet.

IT IS interesting to note that one fourth the present membership of the Society for the Promotion of Agricultural Science is composed of botanists, and that so large a part as one-third of the papers printed in the proceedings for 1888 are botanical.

MR. F. H. KNOWLTON has in preparation a manual of palæobotany, which he hopes to have ready for the press by the end of the following year. The work will be illustrated from American material as far as possible, and will give an account of all the orders, and, when possible, the genera, of fossil plants.

THE WESTERN SOCIETY OF NATURALISTS met at the University of Illinois, October 24 and 25. A number of papers were read, relating to the teaching of botany. The following botanists were present and took part in the discussions: J. C. Arthur, Purdue University; W. J. Beal, Agricultural College of Michigan; T. J. Burrill, University of Illinois; D. H. Campbell, Indiana University; John M. Coulter, Wabash College; Stanley Coulter, Purdue University; Thomas McBride, Iowa University; W. H. Hatch, Rock Island; Charles Robertson, Carlinville, Ill.

FINE SPECIMENS of silicified wood (unnamed), suitable for cabinets and for microscopic study, have been sent us by Mr. Edgar Cherry, of Santa Rosa, California. He speaks of a petrified forest thirteen miles from Santa Rosa, covering twenty acres, and containing many large tree trunks in excellent preservation.

REV. A. B. HERVEY, of Taunton, Mass., recently became president of St. Lawrence University, Canton, N. Y. He is the author of "Sea mosses: an introduction to the study of marine algæ," and has, from time to time, rendered botany good service by translating works from the German. We hope his new duties will not draw his attention away from botanical pursuits.

DURING THE PAST season, Mr. F. H. Knowlton has been collecting fossil plants in the National Park, and has had excellent success. He writes of some slabs of stone a foot square containing half-a-dozen or more perfect leaves, ferns *in fruit*, and other prizes. In addition to the collections of fossil plants, he found time to gather living species, some of which are new to science.

MR. PETER HENDERSON, the well-known seedsman and florist of New York city, holds the opinion that a knowledge of general botany is of special service to the floriculturist, and emphasizes his conviction by offering a prize of $100 for the best herbarium of native plants presented by a member of the Society of American Florists. The prize is to be awarded at the annual meeting of 1889.

EBERDT has reinvestigated the conclusions heretofore reached as to the influence of light in the formation of the palisade parenchyma of the leaf. In opposition to the statement of Stahl, the writer agrees in the main with Haberlandt, that it is less the sunlight which brings about the formation of the palisade than the variation in assimilation and transpiration. Especially is this true of the land plants, in which he concludes the illumination is unimportant except as it determines these other functions. (See abstract in Bot. Centralblatt, xxxv, 332.)

VERY COMPLETE herbarium specimens, including fruits and seeds, accompanied with dissections, both dry and in alcohol, are being prepared by M. Buysman, of Middelburg, Holland, and sold at twenty cents each, or forty cents for tropical species. Sets will be arranged to meet the wishes of purchasers. Mr. Buysman has been preparing and distributing such collections for some time, and his work has been commended by such eminent botanists as Professors Morren, de Bary, Engler, Oudemans and Rauwenhoff. He will be glad to correspond (in English) with any person willing to supply material for the distribution. Reasonable compensation is offered for fine material.

IN THE REVISED Gray's Manual, which is to be ready for the press next month, is to be included a revision of the Hepaticæ by Dr. Lucien M. Underwood. This will be of great advantage to students, as it will make more accessible diagnostic descriptions of these interesting plants, and, we hope, encourage their collection and study. There will be considerable changes from the "Catalog" published by the Illinois Laboratory of Natural History for Dr. Underwood some years ago, as much material has been accumulated since then. We wish a similar revision of the mosses might have been included. They can hardly be said to be suitably provided for by the Manual of Lesquereux and James.

DR. ALFRED FISCHER has demonstrated in an important research on various species of trees that glucose is a constant form of reserve material. The uniform statement of the text-books heretofore has been that all the glucose is transformed into starch for storage. But a study of twigs of trees in winter, using Fehling's solution, demonstrates clearly the presence of glucose. It is especially abundant in the cortex, but occurs also in the wood and pith. It is found either in dead cells (*i. e.*, those which have lost their protoplasm), or in the cell walls. It does not occur in living cells. Dr. Fischer is of the opinion that it must be considered as material which has escaped, by its presence in these places, transformation into starch. For the paper, see *Botanische Zeitung*, xlvi, 405.

M. PRILLIEUX has announced to the French Academy of Sciences (Comptes Rendus, cvii. 447) the successful issue of an experiment with "Bordeaux mixture"—a watery solution of sulphate of copper and lime—in the treatment of the potato-rot. Of the treated plants all the tubers were healthy, while of the untreated more than 32 per cent. were affected. It would seem from the tenor of M. Prillieux' note that this was the first successful experiment in this direction; but this is not borne out by the report of Prof. Scribner for 1887 (Department of Agriculture, p. 331), which indicates the publication in 1886 of experiments which were at least encouraging. The department therefore sent out a circular suggesting the trial of this remedy for the rot, but received no replies.

DEVRIES has suggested[1] a new application of his well known method of plasmolysis, which may prove of much use to chemists in settling the formulæ of organic substances. The method is essentially the determination of the molecular weight of an unknown substance by comparing its plasmolysing power with that of some substance whose molecular weight is known. DeVries illustrates the process by determining the molecular weight of "raffinose," a sugar discovered in 1876, and for which three possible formulæ have been given. Solutions of cane sugar were prepared of definite strength, and likewise of raffinose. The purple epidermal cells on the under side of the leaf of Tradescantia discolor were used as an indicator. On comparing the isotonic coefficients of the substances, a molecular weight of 595.7 was obtained for raffinose. This agrees almost exactly with the weight assigned by one of the formulæ, viz., 594, and settles the composition as $C_{18}H_{32}O_{16}$.

PROF. HALSTED, of the Agricultural College, Ames, Iowa, is prosecuting a special study of American weeds, and desires reports upon the worst (say twenty) of these plant pests in any given locality. A full list of the synonyms of common names for each species will add greatly to the value of the report. It will, of course, be no easy task to balance the points in favor of, and against, some kinds of weeds, but upon this account the deductions from the several reports will be all the more valuable. The work of determining the range, extent of injury, and methods of eradication of our weeds must depend largely upon local observations extended over long periods of time, and we trust our fellow botanists and other interested readers will gladly aid in furnishing the desired information. Any one having a duplicate local printed list of plants or of a county or even a state, can most readily answer the question, Which are your worst weeds? by checking off the species, beginning with one (1) for the worst, and so on as far as possible. Satisfactory credit will be given to all who are pleased to aid in a more complete knowledge of the weeds of America.

[1] Bot. Zeit. xlvi. 393.

THE PROCEEDINGS of the Society for the Promotion of Agricultural Science for the 1888 meeting have been distributed. The botanical subjects are as follows: Flora of the jack-pine plains of Michigan, by W. J. Beal, chiefly an enumeration of seventy-two of the most characteristic species of that region; Notes on fungus diseases in Massachusetts in 1888, by W. G. Farlow—an account of the first appearance at Newton, Mass., the present year, of Sphaceloma ampelinum, the anthracnose of the grape, and its destructive character, of the alarming extension of the hollyhock disease, Puccinia Malvacearum, since its first appearance in 1886, also notes on Peronospora viticola and Æcidium Fraxini; in the two topics, Potato flowers and fruit, and Tomato flowers and fruits, B. D. Halsted notes the sparsity of pollen in some varieties of potatoes, and the uniformity of the number of parts of the tomato flowers on the same plant with the slightly less number of cavities in the fruit; Some preliminary notes upon the relation of our native and naturalized flowering plants to soil and climate, by W. R. Lazenby; New observations on the fungus of black rot of grapes, and Successful treatment of black rot, by F. L. Scribner: A further study of the dandelion: a phase of evolution, by E. L. Sturtevant: to which may be added G. C. Caldwell's paper on the Present aspects of the question of the direct utility of the free nitrogen of the atmosphere for plant food.

DR. ISTVANFFI, of Klausenburg, describes (Bot. Centralblatt, xxxv, 343) methods for preparing various sorts of fungi. In alcohol one can preserve smaller fungi which are desired only for microscopic researches, Gasteromycetes most Ascomycetes, of the Hymenomycetes the colorless Agaricineæ and Polyporei but never the Boleti, and the Hydnei, Clavariei, Theliphorei and Tremellini. Salt water preserves the color and form better than alcohol, but preserves only for a short time. In addition to this fluid, a 0.1 p. c. solution of corrosive sublimate and a 2 p. c. solution of boric acid have been found useful. But the most difficult to preserve are the large Agaricineæ. For these the writer describes in detail the "section method." These fungi are best collected in clear weather immediately following a rain. They should be prepared the same day as collected, or, if this is not possible, they may be preserved for one or two days by being placed between moss under a bell jar. Spore preparations are to be made in the well-known way, and fixed by floating the paper, in the case of dark-spored species, in a fixative made of alcohol (200 gm.), sandarac (5 gm.), mastic (10 gm.) and Canada balsam (10 gm). In the case of the white-spored species, the fixative should be sprayed on with an atomizer, or they may be floated in a solution of ½ gm. of cooking-gelatin in 100 gm. of 20 p. c. alcohol, kept warm on a water bath. For the reception of the sections a gelatinized paper is to be prepared. For this purpose dissolve 100 gm. of gelatin in 500 gm. of water, and spread the hot solution as thickly and evenly as possible on strong white paper; dry the paper on a line and keep under pressure. A longitudinal section through the center of the fungus (0.5–1 mm. thick) is laid upon the paper after first moistening it. The whole of the membrane of the pileus and that of the stipe are also mounted on the paper after removing the flesh. The sections are then dried as ordinarily. For further details the paper must be consulted. Compare also this journal, xii. 271.

24785

GENERAL INDEX.

Names of new species are printed in **Bold-Face** type; synonyms in *Italics;* † signifies death.

A

A. A. A. S., Cleveland meeting, 195, 196; botanical club, 242; registration, 247; botanical papers at, 274; proceedings of botanical club, 230; secretaryship section F, 248
Abbott's "Comparative chemistry of higher and lower plants," 277
Abietineæ, hygroscopic movements of cone-scales, 236
Acer campestre, cork wings, 281; Monspessulanum, cork wings, 282; nigrum 214; saccharinum, 214
Actinonema Rosæ, 196
Adoxa Moschatellina, affinity, 278
Agaricus campestris, nutritive value, 71; melleus, 15
Agave, species of N. A. desert, 264
Agricultural department, bulletin, 136; bulletin on fungicides, 172; results of mycological work in, 14; experiment stations, botany at, 138; duties of new, 97; reports, 279; report of N. Y., 70; science, society for promotion, 325; botanical papers before, 328
Aleurone grains, 218, 247
Alexipharmics, 100
Algæ on animals, 196
Alien's "Characeæ of America," 67
Altitude, effect on blooming, 271
Amateur botanists, work of, 62, 63
Amelanchier oligocarpa, 218
Ami's "Flora Temiscouatensis," 217
Amorpha canescens, Meehan on, 48
Ampelopsis Virginiana, two forms of, 233
Amphicarpæa monoica, Meehan on, 18
Anderson, F. W., appointment, 278
Andropogoneæ, Hackel's revision, 235
Andropogon, changes in nomenclature, 294; provincialis, dioecism, 302
Anemone dichotoma, abnormal, 127
Angelica arguta, 80; **Hendersoni,** 80
Anneslia **Quetzal,** 28
Archaeopnyton Newberryanum, Britton on, 171
Ardisia **Tuerckheimii,** 74
Arisæma triphyllum, acridity of, 232
Arthur, J. C., to Europe, 137; return, 195
Asclepias tuberosa, var. **flexuosa,** 234, 271
Asplenium **Vera-pax,** 77
Assimilation, conditions of, 34
Aster, double, 279
Australia, imported fruit trees, 304
Azalea nudiflora, 230

B

Bailey, Jacob Whitman, biography, 118
Bailey, L. H., appointment, 138; to Europe, 196; lectures, 23
Baker, W., appointment, 23
Baker's "Fern Allies," 22
Balfour, Bayley, appointment, 105
Barberry, destruction of, 137
Bark, 249, 281, 312
Bauhinia **Pansamalana,** 27; **Rubelcruziana,** 27
Bees and flowers, effect of wind on, 33
Beleropone **Pansamalana,** 75
Berberis repens, Puccinia on, 126
Berkeley, types of, 302
Berthoud, E. L., collecting, 46
Bessey, C. E., to Europe, 171; "Grasses and forage plants of Nebraska," 172
Bibliography, J. W. Bailey, 121; Gray, 280
Biography, J. W. Bailey, 118; DeBary, 59; Gray, 49
Biological laboratory, new marine, 220
Blepharipappus **lævis,** 73, *scaber,* var. *lævis,* 73
Boswell, J. T. L., †, 69
Botanical Society, German, 125
Bovista, Massee on, 171
Brandegee's "Flora of Sta. Barbara Isls.," 303
Brasenia peltata, Schrenk on, 70
Bread, fermentation of, 140
Brendel's "Flora Peoriana," 48
Bretfeld, H. Freiherr von, †, 137
Brown University, gift to, 127
Brunella vulgaris, 154
Bryn Mawr, professorship of botany, 247
Buchloe dactyloides, 215
Buchtien's "Development of prothallium of Equisetum," 20
Bundle sheath, function of, in root, 248
Burgess' "How to study botany," 277

C

Cacalia tussilaginoides, a correction, 322
Cactaceæ of N. A. desert, 262
Calcium salts, Schimper on rôle of, 139
Calcutta, botanic garden at, 107
Calea **trichotoma,** 299
California, Euphorbias, 325; Hepaticæ, 112; LeConte on flora of coast islands, 24; flowers of, 136
Callitriche, inflorescence of, 236, 296
Campanula Americana and insects, 225

Campbell, D. H., appointment, 247; return from Europe, 195; "Staining living nuclei," 104
Camptothecium **Amesiæ,** 202
Campylopus **Henrici,** 197
Canada, flora of James bay, 115
Capsicum, variability of fruit, 231
Cardot's "Revision des Sphaignes de l' Amerique du Nord," 66
Carex, **ablata,** 82; adusta, var. *congesta,* 88; aperta, 84; *aperta,* 85; var. *minor,* 85; arctata var. **Faxoni,** 87; Bolanderi, var. *sparsiflora,* 87; *Buckleyi,* 86; canescens, 85; canescens, var. alpicola, 86; var. *sphærostachya,* 86; var. *vitilis,* 86; var. **vulgaris,** 86; curta, var. *brunnescens,* 86; Deweyana, var **sparsiflora,** 87; flava, 83; var. minor, 84; var. **rectirostrata,** 84; *frigida,* 82; grisea, 82; var. angustifolia, 83; var. **globosa,** 83; var. *minor,* 83; *Haydenii,* 85; Jamesoni, var. **gracilis,** 88; *laxiflora,* 83; Lindoni, var **incerta,** 88; **luridaX retrorsa,** 88; **pansa,** 82; *Richardii,* 86; rosea, var ? **Arkansana,** 87; salina, var.? **robusta,** 87; *Smithii,* 88; *sphærostachya,* 86; stricta, var. **decora,** 85; triceps, var. **Smithii,** 88; *vitilis,* 86
Carter's "Synopsis of Medical Botany of U. S.," 277
Castalia **Leibergi,** 124
Castillo's "Illustrationes," 217
Cephalanthus occidentalis, Meehan on, 48
Chara **compressa** (fossil), 156; of N. Idaho, 165
China, flora of, 279
Chlorophyll, Moore on epidermal, 24; of young fruit, 279
Chromoleucites, Courchet on, 279
Chrysochlamys **Guatæmaltecana,** 26
Cicuta maculata, death from, 128
Cienkowski, L. von, †, 23
Cinchona, Rusby on, 23
Cleistogamy in Orchids, Ridley on, 138
Clover rust, 301
Cobæa **triflora,** 75
Coca, Rusby on, 171
Coelopleurum Gmelini, 145; **maritimum,** 145
Collins' (Dame and) "Flora Middlesex co., Mass.," 278
Compositæ, elastic filaments of, 230; irregularity in tubifloral, 231; of N. A. desert, 263; of N. C. mountains, 270; a poisonous species, 219
Coniotherium diplodiella, 14
Conjugation of Spirogyra, 280
Convolvulus sepium, abnormal, 127
Cork wings, development of, 249, 281, 312
Corn, pollination of, 242
Coville, F. V., appointment, 195
Cretaceous flora, 70
Croft's "List of Texas plants," 137
Crozier, A. A., appointment, 137
Cyclopus Blitt, 57; candidus, 56; cubicus, 57; Portulacæ, 57

D

Damatophora necatrix, 15
Dame and Collins, "Flora of Middlesex co., Mass.," 278
Dallinger, W. H., resignation, 195
Date palm fungus, 211
Dawson's "Fossil woods of the northwest," 66; "Geological history of plants," 167
Day's "Catalogue of Niagara plants," 247
DeBary, Heinrich Anton, †, 46; biography, 59; Dudley on death of, 64; "Lectures on bacteria," 134
Delamare, Dr., †, 247; "Flora Miquelonensis," 168
Delphinium, color variation in, 216; and insects, 228
Dentaria laciniata and multifida, 234
Desert plants of N. A., 258
Desmius of N. C., 278
Desmodium canescens, 152
Dichogamy, cause and significance, 237
Dickson, Dr. Alex., †, 46
Dicranella **Fitzgeraldi,** 197
Diervilla **rivularis,** 191
Dietz's "Development of flowers and fruit of Typha," 40
Discomycetes, Phillips on British, 46
Diseases of plants, 44, 106, 137, 193, 196, 211, 327
Disporum, nomenclature of, 162
Doassansia, DeToni's revision of, 138
Dorstenia Choconiana, var. **integrifolia,** 76
Drude's "Atlas der Pflanzenverbreitung," 103
Drying botanical specimens in sand, 272
Dudley, W. R., return from Europe, 195; "Plants of Lackawanna and Wyoming Valleys," 104

E

Elaters of Equisetum, 176
Encelia **pleistocephala,** 189
Engelmann's "Collected works," 102
Engler and Prantl's "Die natürliche Pflanzenfamilien," 24, 133
Ephedra, structure of stem, 265
Epidermis, Moore on chlorophyll in, 24
Equisetum, spore dissemination, 173
Erigeron **Tweedyi,** 17
Eryngium **armatum,** 141; articulatum, 142; **Floridanum,** 142; petiolatum, 141; var. *armatum,* 141; var. *juncifolium,* 142; **Vaseyi,** 142.
Erythræa Centaurium, 231
Euonymus alatus, cork wings, 312; Europæus, cork wings, 312
Euphorbia, Californian, 325: serpyllifolia, exploding fruits, 271
Exchange Club, 36, 132, 160, 161, 240; for Thallophytes, 129

F

Farlow's "Memoir of Tuckerman," 104; "Supplemental list of works on N. A. fungi," 172
Farlow and Seymour's "Host Index of fungi," 245
Fermentation of bread, 140
Ferns, Stout herbarium, 127; Yates on, 70
Fertilization (See pollination)
Fissidens, measurements of cells, 99
Fixing growing points, 8
Fletcher's "Smuts attacking wheat," 135
Folk-lore of plants, Dyer on, 325
Fontinalis **flaccida,** 201; **Howellii,** 200
Forestry, convention, 70; Michigan commission, 192

Forests, and rainfall, 47; succession of in Michigan, 239
Fossil flora of Dakota group, 70; Chara, 156
Fruit, chlorophyll of, 279; exploding, 271; trees imported into Australia, 304
Fuchsia, malformed, 98
Fucus, apical cell of, 170
Fungi, parasitic, of Missouri, 213; photographing, 137; preparing for herbarium, 328; types of Curtis herbarium, 302; Winter herbarium, 279
Fungicides, bulletin on, 172

G

Galloway, B. T., appointment, 247
Garden, royal botanical, at Calcutta, 107; at Trinidad, report of, 279
Gentianaceæ, proposed monograph, 304
Geographical distribution, 24, 46, 89, 94, 95, 115, 268, 269, 301, 318, 322, 323, 325
Geranium maculatum and insects, 203
Germ of Southern cattle plague, Billings on, 105
Gilson's "Trees of Reading, Mass.," 70
Glucose, storage in trees, 327
Goodale, G. L., appointment, 140; lectures on forests, 165
Goff on physiology of roots, 137
Gonolobus veluti nus, var. **calycinus,** 189
Gonzalea **thyrsoidea,** 188
Göttingen botany at University of, 287
Grape, Viala and Ravaz on black rot, 44; notes on Illinois, 95; Viala on U. S., 107
Graphiola Phœnicis, 211
Grass, experimental station for, 69, 167; synopsis of Panicum, 96; Vasey and Scribner on new species, 47
Gray, Asa, †, 25, 38; bibliography, 280; biography, 49; notices of, 248; in Gardener's Chronicle, 108; in Journal of Botany, 195; Hooker on, 139; last writing, 105; memorial of American Academy, 280, memorial chapter Agassiz association, 172; memorial by Harvard University, 137; memorial meeting of Philadelphia Academy, 248; personal reminiscences of, 178; resolutions on death of, 231, 232; testimonial to, 60
Gray's "Elements of Botany," 41; "Manual," Hepaticæ of the revised, 326; "Notes on polypetalous genera and orders," 136; "Synoptical Flora—Gamopetalæ, 172
Greene on nomenclature, 136
Greeneria fuliginea, 14
Grimaldia **Californica,** 114
Guatemala, undescribed plants from, 26, 74, 188, 299

H

Haberer's "List of Utica plants," 218
Hackel on Andropogon, 294
Hallowell, Miss S. M., in Berlin, 46; return from Europe, 195
Halsted, B. D., articles in Chautauquan, 137; "Bulletin botanical dep't," 172; on California flowers, 136
Hanburia **parviflora,** 299
Harpalyce **rupicola,** 26
Harvard University, summer school of botany, 195
Henslow's "Origin of floral structures," 324
Hepaticæ, new Californian, 112
Herbarium, Buysman's specimens, 326; case, 16; Curtis, types of, 302; exchange, 99; Henderson prize, 326; Philadelphia Academy, 137; preparation of fungi for, 328; Stout, of ferns, 127; Winter, 279
Hervey, A. B., appointment, 326; Strasburger's "Practical Botany," 104
Hibiscus incanus, 73; lasiocarpus, 73, 204
Hieracium **Howellii,** 73
Hillebrands, "Flora of Hawaiian Is.," 166
Homalothecium **Nevadense,** 202
Honeysuckle, adaptation and insects, 237; mutilation by insects, 39
Hooker, Miss H. E., to Europe, 218
Hooker, Sir J. D., medal to, 24
Humphrey, J. E., appointment, 304
Husnot's "Muscologia Gallica," 20, 246
Huth's "Die Kletterpflanzen," 104
Hydrangea, objects of cross-fertilization, 236
Hypnum *Nevadense*, 202

I

Idaho, collecting in, 164
Illinois, notes on grapes of, 95
Imbedding, in paraffin, 5, 61, 130, 158; in soap, 196
Immunity from contagion, 240
Impatiens and insects, 208
Indiana, Academy of Science, bot. papers at, 72; plants, 323
Index seminum, 69
Insects and flowers, 33, 39, 146, 151, 203, 237, 228, 276
Isoetes, distribution of, 89; **maritima,** 94; **Mexicana,** 93

J

James, J. F., appointment, 248
James bay, flora of, 115
Journals: Acta Horti Petropolitani, 72; American Naturalist, 70; Botanisches Centralblatt, 278, 325; Bulletin Torrey Botanical Club, 47, 72, 106, 136; Garden and Forest, 47, 69, 108, 171, 218; Journal of Botany (Brit.), 69, 218; Journal of Botany (Ital.), 70; Journal de Botanique, 138, 218; Journal Ital. Agric. Stations, 70; Journal of Mycology, 47; Kew Bulletin, 1-7, 172; Pittonia, 24; West American Scientist, 23
Jungermania **Bolanderi,** 113; **Davidsoni,** 113; Muelleri, var. **Danaensis,** 114; **rubra,** 113

K

Kohl, G. F., editor Bot. Centralblatt, 278

L

Lablatæ, gyno-dioecious, 230
Laboratory, Göttingen, 287; marine, at Wood's Holl, 304; Oxford, 221; plan for, 32; Strassburg, 305; Tubingen, 1; work, results of, 63
Læstadia Bidwellii, stylospores, 15
Lamourouxia **integerrima,** 189
Leaf, formation of palisade tissue, 326
Leguminosæ, of N. C. mountains, 269; root-tubercles of, 23, 196
Leitgeb, Hubert, †, 172
Lespedeza violacea, 152
Lichens from Easter Is., 94

Life-histories, Meehan on, 48; study of, 192
Light and palisade tissue, 326
Ligusticum apiifolium, 145; scopulorum, 145
Linaria and insects, 228; vulgaris, peloric, 274
Linnean society, centenary, 220
Linum perenne, white-flowered, 215
Liquidambar Styraciflua, cork wings, 282
Lonicera and insects, 237
Luerssen, Dr. C., appointment, 105
Lycoperdon giganteus, nutritive value of, 71
Lyford, J. C., lectures, 105

M

Macoun's (J.) "Catalogue of Canadian plants," 276
Macoun (J. M.) collecting trip, 71.
Maine plants, 322.
Maple, black, 213.
Marsilia Ægyptiaca, germination, 235
Masters, M. T., election, 218
Medicago, Uromyces on, 302
Melampodium **brachyglossum,** 74
Melampyrum, secretion of nectar by, 106
Melanconieæ, Trail on, 171
Mentha, Schrenk on, 218
Michigan, comparison of E. and W. flora, 238; forestry commission, 192; succession of forests in, 239
Micron, 218
Microscopes, American vs. foreign, 38
Mikania **pyramidata,** 188
Mildews, downy, of Iowa, 52
Mimicry, Rothrock on, 196; seeds of Melampyrum, 106
Mimosa **sesquijugata,** 74
Mimulus alatus, 153; ringens, 153
Missouri, parasitic fungi, 213
Mistleto, Jost on development, 219
Möbius' "Anatomy of leaves of Orchidaceæ," 71
Monarda fistulosa, 154
Morgan's "Mycological flora of Ohio valley," 69
Morong, expedition to S. A., 107, 132, 195
Mosses, of Idaho, 164; new to North America, 197, 241
Müller's "Sphagnorum nov. descriptio," 68
Museum, 78.
Mushrooms, nutritive value, 71
Mycological work in Dep't of Agriculture, 14
Mycologist, report of U. S., 132
Myriocarpa, *heterospicata,* 29; **heterostachya,** 29

N

Naturalists, botanists at western society of, 325
North Carolina, collecting in mountains, 269, 318; Prunus pumila in, 95
Nebraska, plants of, 301
Nephrodium **Tuerckheimii,** 190
Newbouldia lævis, Schrenk on bark, 279
Newell's "Outlines of lessons in Botany," 135
New York, Agric. Exp. Sta. report, 70; city and vicinity, flora of, 171; report of botanist, 71;
Nomenclature, 272; Britton on, 235; DeCandolle on, 244; discussion, 161; Greene on, 136; Hackel on, 234, 243; of Disporum, 162; of Nymphæa, 47, 70
Nostocaceæ of French herbaria, 248
Nymphæa, nomenclature of, 47, 70

O

Odors of flowers, 98, 300
Œnothera albicaulis, odor, 300
Ohio (Franklin co.) flora, absence of Ericaceæ, 235
Oliver's "Structure of Trapella," 278
Orchidaceæ, Möbius on anatomy of leaves, 71; and insects, 207; Ridley on fertilization, 138
Orthotrichum, Gronvall on Venturi's revision of, 106
Owen's "Catalogue of Nantucket plants," 277
Oxalis, subterranean shoots, 191
Oxford, bot laboratory at, 224
Oyster's new catalogue, 46

P

Palæobotany, Knowlton's Manual announced, 325
Palisade parenchyma, formation of, 326
Palmer, Mexican collection, 69
Palm, fungus on date, 211
Pammel's "Pollination of Phlomis and perforation of flowers," 276
Pandie, Dr J., †, 136
Panicum, synopsis of, 96
Papilionaceæ and insects, 206
Paraffin, imbedding in, 5, 61, 120, 158
Peck's "Bulletin of New York Museum," 72; "Report of botanist," 71
Peloria of Linaria vulgaris, 274
Periderm, 249, 281, 312
Peronospora alta, 55; Arthuri, 55; calotheca, 56; Claytoniæ, 54; effusa, 55; Euphorbiæ, 55; gangliformis, 54; Geranii, 54; graminicola, 56; Halstedii, 53; Lapponica, 172; leptosperma, 55; Lophanthi, 56; obducens, 53; parasitica, 54; Polygoni, 55; Potentillæ, 54; pygmæa, 54; sordida, 56; Trifoliorum, 55; viticola, 15, 53
Peruvians, economic plants of ancient, 220
Peucedanum **Austinæ,** 208; **Brandegei,** 210; Californicum, 143; **Canbyi,** 78; **Donnellii,** 143; Geyeri, 79; **Grayi,** 209; **Hendersonii,** 210; **Martindalei,** 142; var. **angustatum,** 143; *millefolium,* 209; nudicaule, 79, **Parishii,** 209; **Pringlei,** 209; **Sandbergi,** 79; **Vaseyi,** 144; **Watsoni,** 209
Pfeffer, W., portrait, plate I
Phacelia **heterosperma,** 37
Phellopterus littoralis, 81
Phillips' British Discomycetes," 101
Phœnix dactylifera, fungus on, 211
Phoma uvicola, 16
Photography of fungi, 137
Phyllosticta labruscæ, 16
Physalospora Bidwellii, stylospores of, 15
Phytophthora infestans, 53
Pimpinella apiodora, 81
Pitcairnia **Tuerckheimii,** 190
Planchon, Morot's biography, 218
Plasmolysis, new application of, 327
Plowright on British Uredineæ and Ustilagineæ, 108
Plums, diseased, 193
Pneumatodes, Jost on, 106

Podosciadium, 77; Bolanderi, 78; Californicum, 78
Poisonous plants, 19; White on, 41
Pollen, causing hay fever, 138; germination and measurement, 238; resistance to external influences, 138; sought by silk, 242
Pollination, 146, 157; of corn, 242; cross, objects of, 151, 236; secondary effects of, 233
Polytrichum commune, plate XVII; formosum, pl. XVII; gracile, pl. XVII; Ohioense, 199
Porter, T. C., to Europe, 136
Postage on botanical specimens, 60
Potato, rot, Bordeaux mixture for, 327; scab, cause of, 106; tuber, Arthur on, 218; office of, 106
Poteat's "List of N. C. Desmids," 278
Pourridie, 15
Prantl, appointment declined, 136
Pringle, C. G., return, 19
Pringsheim on assimilation, 34
Prosartes, nomenclature, 162
Proteids, manufacture of, 139
Protogyny in Umbelliferæ, 193
Prunus Americana, disease, 193; pumila in N. C., 95; Virginiana, var. **leucocarpa,** 233
Pseudophœnix, figures of, 280
Psiadia rotundifolia, 71
Psoralea Onobrychis, 152
Puccinia, graminis, changes in hosts by, 235; mirabilissima, 126; Prunispinosæ, 16
Pycnanthemum lanceolatum, 154

Q

Quercus macrocarpa, cork wings, 254

R

Ramularia Tulasnei, 16
Rhaphides, Stahl on, 24
Ranzania, 304
Respiration, heat given off in, 220
Rhacomitrium **Oreganum,** 198
Rhizocarpeæ, systematic position of, 238
Robinson's "Notes on Taphrina," 68
Roestelia penicillata, 16
Roll's expedition, 172
Roots, mechanics of absorbing, 248; pressure, Clark on, 219
Rose, J. N., appointment, 195
Roses, black spot on, 196
Ruellia strepens, 154
Rust, clover, 301; Dietel's enumeration of, 23, 304

S

Sabbatia angularis, 152
Saccardo's "Sylloge Fungorum," 171
Salix, balsamifera, 171; Californica, 109; **commutata,** 110; **conjuncta,** 111; glauca, 109; phylicoides, 186; villosa, 109
Sanford's "Anatomy of cedar apple," 217
Sanicula **Howellii,** 81; laciniata, 80
Saporta's "Origin des arbres cultivées," 275
Sarracenia, decay of pitchers at Kew, 72; insectivorous, 170
Schiffner's "Verbascum-hybriden," 69
Schönland's Bower's "Development, etc., of Phylloglossum," 68
Schultz's "Bestaubungseinrichtungen," 134
Scribner, F. L., appointment, 139; experiments in treatment of grape diseases, 217
Scropularia nodosa, 153, 226
Scutellaris **lutea,** 76
Sections, cutting ribbon, 10
Seedlings, action of frost on, 107
Seeds, dispersion of, 139; exchange list of Jardin des Plantes, 69; longevity of Coniferous, 219; of Melampyrum, 106; vitality of, 18
Selinum **Dawsoni,** 144; **Grayi,** 144
Septosporium Fuckelii, 15
Shaw school of botany, 136
Silene Pennsylvanica, 151; regia, 151
Silphium laciniatum, fabulous account of, 304
Smith, E. F., investigating peach yellows, 195
Smithsonian institution regency, 69
Solms-Laubach, Count H. von, appointment, 23, 136; editor Bot. Centralblatt, 219
Sphærella Fragariæ, 16, 234
Sphæropsideæ, Trail on, 171
Spirogyra, rate of conjugation, 280
Sporangium of Equisetum, 173
Spores, dissemination of Equisetum, 173; measurements, Cooke on, 106
Stachys cordata, 155
Staining sections, 12, 61
Starch, formation of, 43
Stem of Ephedra, anatomy of, 265
Stevenson's "Index to habitats of Ellis' fungi," 172
Stigmaria, Williamson on, 43
Stone, W. E., appointment, 139; return from Europe, 195
Strasburger's "Botanisches Practicum," 21
Strassburg, bot. laboratory at, 305
Strawberry, poisonous ?, 19, 100, 131; proliferous, 279
Succulents, society for, 46
Sycocarpus Rusbyi, Schrenk on bark, 279

T

Tannins, functions, 218
Taraxacum, variation of, 236
Tecoma radicans, 153
Tennessee, Agricultural experiment station, organization of, 139
Teratology, 98, 127, 172, 274, 279
Thallophytes, exchange club, 129
Thaxter's "Entomophthoreæ of U. S.," 194
Thümen, von, on fungi of cultivated fruits, 137
Thyrsacanthus **geminatus,** 75
Tilia, functions of peduncular bract, 234
Tillandsia, Baker's revision of, 218
Timber, diseases, Ward on, 46; durability, 136
Trees, Fernow's definition of, 231; storage of glucose, 327
Trelease, W., to Europe, 140, 195; "Bacteria from botanical standpoint," 71; "N. Am. Geraniaceæ," 216
Trifolium, Uromyces on, 301
Triolena **paleolata,** 28
Troximon barbellulatum, 73
Tuber, office of potato, 106
Tubercles on roots of Leguminosæ, 23, 196
Tübingen, bot. institute at, 1
Tuckerman's "Synopsis of N. A. Lichens," 277

Typhaceæ, Morong on, 72, 106; Dietz on 40; use of leaves, 98

U

Ulota phyllantha, discovery of fruit, 219, 279
Umbelliferæ, notes on western, 77, 141, 208; protogynous, 193
Uncinula polychæta, 29
Underwood, L. M., to California, 218; "Native Ferns," 69, 169
Uredineæ, Dietel on, 23, 304
Uredo ficus, 16
Uromyces Betæ in U. S., 15; Medicagenis-falcatæ, 302; Trifolii, 301
Utah, Jones on flora of, 46

V

Vacuoles, 218, 280
VanDeman's "Tropical and semi-tropical fruits," 247
Vasey's "Grasses of arid districts," 217
Vegetation characteristic of N. A. desert, 258
Vegetable, new, 47
Veronica peregrina, 157
Vernonia nigritiana, 219
Vernoniæ, 219
Viala on U. S. Vitis, 107; visit to U. S., 48; "Les maladies de la vigne," 45
Vines, S. H., appointment, 196
Viscum album, Jost on development, 219
Vitis Californica, fungus on, 15; notes on Illinois species, 95; Viala on U. S., 107
Vochysia **Guatemalensis,** plate XXIII

W

Waldner's "Entwickelung der Sporogone von Andræea und Sphagnum," 68
Water lily, a new, 124
Watermelon, polygamous flowers of, 224
Watson's "Contributions—XV," 194
Ward's "Asa Gray and Darwinism"
Warnstorf's "Sphagna exsiccata," 172
Washington, biological society of, 47, 71; botanical club lecture course, 47
Washingtonia filifera, 264
Webera **camptotrachela**, 199
Weeds, Halsted on American, 327
Wheeler's "Flora of Milwaukee co., Wis.," 170
White's "Dermatitis venenata," 41
Wigand's "Nelumbium speciosum," 276
Williamson's "Monograph on Stigmaria," 43
Willows, notes on N. A. 109, 186
Wilson's "Sarracenia," 170
Wisconsin, summer school of science, 218
Wood, specimens of silicified, 326
Woodworth's "Apical cell of Fucus," 170

Y

Yates new work on ferns, 70
Yellowstone Park, Knowlton's collections in, 326
Yucca, species of N. A. desert, 263; and Yucca moth, 237

Z

Zanthoxylum **Costaricense,** 190
Zea Mays, pollination of, 242
Zexmenia **Guatemalensis,** 188
Zimmerman's "Pflanzenzelle," 245
Zygomorphy and its causes, 146, 203, 224

INDEX OF AUTHORS.

Anderson, F. W., 271, 272, 300

Bailey, L. H., 82, 213
Bailey, W. W., 100, 128, 274
Barnes, C. R., 99
Beal, W. J., 192, 238, 239
Bebb, M. S., 63, 109, 186
Britton, N. L., 235
Burgess, T. J. W., 60

Campbell, D. H., 1, 40, 125, 158, 238
Canby, W. M., 17
Cardot, J. (Renauld and), 197
Chickering J. W., Jr., 322
Cockerell, Theo. D A., 131, 215
Coulter, J. M. (and Rose), 77, 141, 208
Coulter, Stanley, 118
Crozier, A. A., 18, 99, 242, 244, 302

DeCandolle, Alphonse, 244
Dudley, William R., 64, 305

Evans, Walter H., 265

Farlow, W. G., 49
Foerste, Aug. F., 151

Galloway, B. T., (Tracy and), 29, 126, 213
Gattinger, A., 191
Gray, Asa, 73
Gregory, Emily L., 249, 281, 312

Hackel, E., 243
Halsted, B. D., 52, 238
Harkness, H. W., 132
Hill, E. J., 323
Hitchcock, A. S., 127
Hoag, Julia S., 98, 101

James, Joseph F., 193, 271
Johnson, L. N., 269, 318

Kelsey, F. D., 16
Knowlton, F. H., 43, 66, 94, 156

Leiberg, J. B., 164

Macoun, James M., 115
McGee, Emma R., 301
Meehan, Thomas, 157, 236, 237, 274
Memminger, E. R., 95
Moll, J. W., 5
Morong, Thomas, 124, 132

"N or M" 162
Newcombe, F. C., 173

Pammell, L. H., 216
Peck, C. H., 101
Power, F. B., 59
Prentiss, A. N., 19, 100, 236
Puchner, W. A., 98

Renauld, F. (and Cardot), 197
Riley, C. V., 178
Robertson, Charles, 33, 146, 193, 203, 224, 324
Rose, J. N., (Coulter and), 77, 141, 208

Salmon, D. E., 240
Schneck, J., 39, 95, 98
Schönland, S., 32, 61, 221
Schrenk, Joseph, 236, 296
Scribner, F. L., 14, 19, 44, 294
Smith, E. F., 128, 213
Smith, Jared D., 215
Smith, J. Donnell, 26, 74, 188, 299
Stone, W. E., 287
Sturtevant, E. L., 236

Tracy, S. M. (and Galloway), 29, 126, 213
Trelease, W., 134, 191

Underwood, L. M., 22, 89, 112, 301

Vasey, George, 36, 96, 132, 160, 161, 240, 258

Watson, Sereno, 322

ERRATA.

Page 5, last line, for "1877" read 1887.
Page 9, lines 3 and 5 from bottom, for "Gothic" read L.
Page 16, line 10 from top, for "penicellata" read *penicillata*.
Page 35, line 7 from top, for "ags" read *gas*.
Page 37, after P. heterosperma insert *n. sp.*
Page 40, line 4 from top, for "Schenck" read *Schneck*.
Page 68, line 3 from bottom, read *development and morphology of*.
Page 68, after foot-note 7, insert *p.* 595.
Page 132, line 8 from top, for "Cockrell" read *Cockerell*.
Page 147, foot-note 7, for "Tropœlum" read *Tropœolum*.
Page 163, line 16 from bottom, for "Engelman's" read *Engelmann's*.
Page 172, line 18 from bottom, for "pest" read *host*.
Page 175, line 18 from bottom, for "Sablou" read *Sablon*.
Page 200, line 7 from top, for "Crowdin" read *Crowder's*.
Page 218, line 5 from top, for "Schenk" read *Schrenk*.
Page 218, line 14 from top, for "Aug. 10" read *Aug.* 3.
Page 251, foot-note for "w" read *wiss*.